

What is claimed is:

1. An assembling method for inserting a workpiece into an object at an insertion position using a robot, comprising the steps of:

setting search ranges and different periods of reciprocating motions and allowable ranges within which the workpiece is insertable into the object for a plurality of search directions; and

finding the insertion position by simultaneously performing the reciprocating motions of the workpiece relative to the object in the plurality of search directions while pressing the workpiece against the object in a pressing direction using the robot such that while the workpiece is moved by the set search range in the reciprocating motion of a first period in one search direction, the workpiece is moved by an amount not greater than the set allowable range in the reciprocating motion in another search direction of a second period next shortest to the first period.

2. An assembling method according to claim 1, wherein when a force or a moment greater than a set value is detected in one of the search directions in performing the reciprocating motions, the reciprocating motion in the one search direction is stopped and the reciprocating motions in the other search directions are continued to find the insertion position.

3. An assembling method according to claim 2, wherein the reciprocating motion in the one search direction is resumed when the insertion position is not found for a predetermined time period after the stoppage of the reciprocating motion.

4. An assembling method according to claim 1, further comprising a step of determining that the insertion position is found based on a change of

one of a position, a motion amount and a pressing force in the pressing direction of the workpiece in the reciprocating motions.

5. An assembling method according to claim 1, further comprising the steps of storing the found insertion position in storage means, and starting the finding step for subsequent insertion from the stored insertion position.

6. An assembling apparatus for inserting a workpiece into an object at an inserting position using a robot, comprising:

search motion defining means for defining a composite search motion of simultaneous reciprocating motions of the workpiece relatively to the object at different periods in a plurality of search directions to find the insertion position;

control means for controlling a motion of the workpiece held by the robot to perform the composite search motion while pressing the workpiece against the object; and

detecting means for detecting finding of the insertion position.

7. An assembling apparatus according to claim 6, wherein the reciprocating motions of the workpiece include a rotary reciprocating motion of the workpiece.

8. An assembling apparatus according to claim 6, further comprising means for detecting a force or a moment applied to a distal end of the robot, wherein said control means controls respective axes of the robot based on the detected force or moment by a force control or in accordance with kinetic equations of motion.

9. An assembling apparatus according to claim 8, wherein the force

control is implemented in each of the search directions.

10. An assembling apparatus according to claim 6, wherein said search motion defining means comprises: means for designating the plurality of search directions; means for designating the different periods of the reciprocating motions for the plurality of search directions; means for designating search ranges respectively for the plurality of search directions; means for designating amounts respectively not greater than insertable ranges between the object and the workpiece for the plurality of search directions.

11. An assembling apparatus according to claim 10, wherein said search motion defining means defines a path of the composite search motion based on the search periods, the search ranges, and the amounts not greater than the insertable ranges.

12. An assembling apparatus according to claim 11, wherein said search motion defining means defines the path of the composite search motion such that while the workpiece is moved by the designated search range in the reciprocating motion of  $n$ -th ( $n$ : integer) shortest period in the designated direction thereof, the workpiece is moved by the amount not greater than the insertable range in the reciprocating motion of  $(n+1)$ -th shortest period in the designated direction thereof.

13. An assembling apparatus according to claim 6, wherein when a force or a moment greater than a set value is detected in one of the search directions in performing the composite search motion, said control means stops the reciprocating motion in the one search direction and continues the reciprocating motions in the other search directions.

14. An assembling apparatus according to claim 13, wherein said control means resumes the reciprocating motion in the one search direction when the insertion position is not found for a predetermined time period after the stoppage of the reciprocating motion.

15. An assembling apparatus according to claim 6, wherein said detecting means includes means for detecting that the workpiece is inserted into the object by a predetermined distance.

16. An assembling apparatus according to claim 6, wherein said detecting means includes means for detecting that a pressing force of the workpiece against the object decreases to be less than a predetermined value.